MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2018/2019

EET2066 – POWER TECHNOLOGY

(RE)

6 MARCH 2019
2:30pm – 4:30pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages excluding the cover page with 4 Questions only.

2. Attempt **ALL (4)** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1 [25 marks]

(a) With the help of a diagram, explain the discharging process of a Lead-Acid battery. [6 marks]

(b) With the help of a diagram, explain the principle operation of a variable reluctance stepper motor. [7 marks]

(c) Figure Q1(c) shows a MOSFET with clamped inductive load operating at a switching frequency of 10 kHz and duty cycle of 60%. The inductance of the load is large such that the load current is constant at a value of 13A.

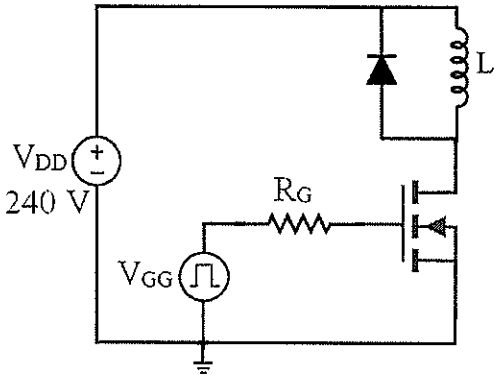

Figure Q1(c)

(i) The diode has V_{th} = 1 V and R_{on} = 0.2 Ω. Calculate the power loss incurred by the diode. [4 marks]

(ii) Determine the total power dissipation in the MOSFET. [8 marks]

Continued...

Question 2 [25 marks]

(a) Figure Q2(a) shows a diode bridge rectifier with negligible voltage drop across all diodes. Calculate for the following:

(i) Average output voltage. [4 marks]

(ii) Commutation overlap angle. [3 marks]

(iii) Prove that the equation for RMS output voltage is given as $V_{o,rms} = \sqrt{\frac{V_{s,rms}^{\ 2}}{2\pi}\left(\pi - \mu + \frac{\sin 2\mu}{2}\right)}$. Hence calculate the numerical value.

[6 marks]

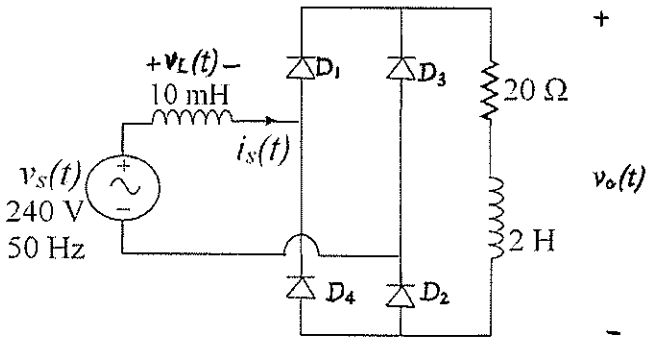

Figure Q2(a)

(b) A buck–boost converter supplied with 24 V source voltage has 0.35 A average source current. The converter operates under continuous conduction mode and generates 16 V output voltage at 20 kHz with duty cycle of 0.4. Design the converter such that maximum inductor current is less than 1A and ripple voltage across the resistive load is not more than 1%.

[12 marks]

Continued...

Question 3 [25 marks]

Figure Q3 shows a half bridge inverter operating at a frequency of 60 Hz.

(a) Write the Fourier equation for the third harmonic. Hence, find the harmonic factor. [6 marks]

(b) Find the peak load current (I_o) at $t = \frac{T}{2}$. [6 marks]

(c) Time of current zero crossing after start of a half cycle. [3 marks]

(d) Given that $i_L(t) = -I_o e^{-t/\tau} + \frac{V_P}{R}(1 - e^{-t/\tau})$. Find the average current for switch S_1. [10 marks]

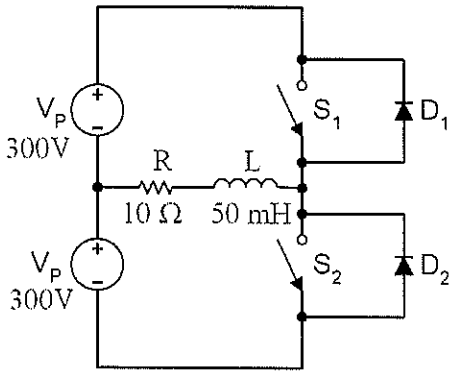

Figure Q3

Question 4 [25 marks]

(a) A semiconductor product has encountered an unusual high failure during test. After investigation, it was found out that the power supply of test machine has substantially caused a higher voltage to the device under test. As an engineer, you are required to design a voltage protection circuit for the power supply. Explain how your design is able to protect the device under test from a higher voltage than it was designed to handle. [12 marks]

(b) (i) Provide two major limitations of a permanent magnet DC motors. [4 marks]

(ii) With the aid of diagram, discuss a method which is able to overcome the limitations stated in part (i). [9 marks]

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